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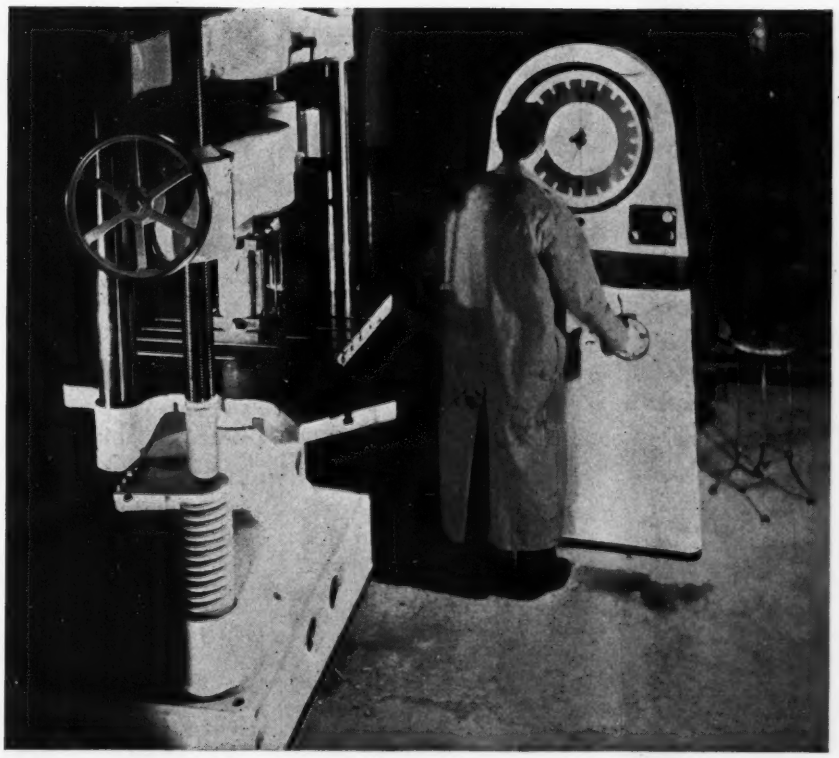

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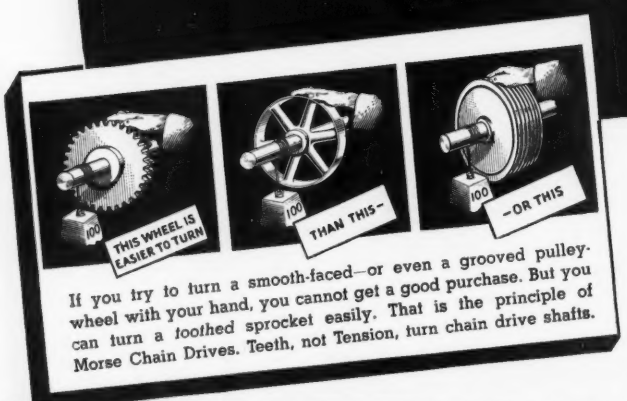
SMOKE ABATEMENT

By William G. Christy, '11 M.E.

Volume 2 APRIL, 1937 Number 7

Teeth Not Tension

The Simple Formula For POWER TRANSMISSION EFFICIENCY



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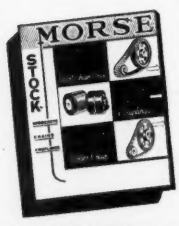

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Checkmates Corrosion

Welding aids modern metallurgy to produce completely corrosion-proof assemblies

EQUIPMENT is subject to corrosive attack and consequent deterioration by three forces: chemical attack, electrolysis and erosion. Chemically active gases, liquids, pastes, or solids eat away the more easily attacked portion. Dissimilar metals often set up galvanic currents, which cause pitting and corrosion. High-velocity steam or solid particles in a slurry add mechanical abrasion to the ravages of chemical and galvanic attack.

Welding Prevents Deterioration

Welding is a valuable aid to users and fabricators of equipment for corrosive service. By welding, equipment can be made smooth, jointless—one-piece. Valves and necessary fittings can be faced with corrosion-resistant metal welded in place. Chemical attack can be further prevented by making welds of material similar to the body metal.

Welded assemblies present a smooth, unbroken internal surface. No pockets are formed in which concentration and consequent deterioration can occur.

Galvanic attack, which occurs with other types of assembly, ceases to be a factor in welded equipment. In a welded assembly, the same or similar metals are fused together. Perfect electrical contact prevents the damage due to galvanic action. Abrasion by steam, water, or solids is prevented by welding on hard alloys at constrictions and bends.

Welding Stops Corrosion Losses

Abrasion, chemical attack, electrolysis, are defeated on a thousand fronts by welding. New equipment, designed to resist corrosive conditions and fabricated by welding to assure satisfactory performance, is achieving enviable records in service. Equipment which would otherwise be scrapped is renovated and protected against further deterioration. Many corrosion problems, localized in extent, are conquered through the application of resistant materials to the affected parts by welding.

As a result of the successful application of welding to check corrosion losses, industry is saving money. Repair and replacement bills are cut. New machinery and supplies have a longer life, and thus amortization charges are lowered. Less valuable production time is lost through shutdown and accident.

A few of the many ways by which welding checkmates corrosion, selected from actual case histories, appear in the column at the right. These and many other similar welding applications may be utilized in your future business.

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Welding Savings

In the textile industry, stainless steel is used for dye-vats, tanks, buckets, dippers, and many other purposes. The equipment, welded throughout, resists chemical action, is smooth inside and therefore easily cleaned, and is strong and durable.

* * *

Wear by sandy water had pitted the surfaces of two 42-inch diameter balance needle valves so seriously that the valves would no longer operate efficiently. Twenty-two hours of welding saved these expensive semi-steel castings, which otherwise would have been scrapped.

* * *

In redesigning several 700-gallon tanks for food storage, it was necessary to eliminate an unsanitary and corrosion-ridden condition. The tanks were redesigned to be made from stainless steel with welded joints. The inside and outside are now permanently free from undesirable laps where germs might lodge or corrosion might start.

* * *

Sea water had seriously corroded the impellers of cargo pumps on an oil tanker. Five hours of welding repaired this damage at a fraction of the cost of new parts. Resistant metal used for the repair will prevent recurrence of trouble.

* * *

Welded piping in the floor of a skating rink successfully resists severe corrosion in addition to mechanical stress. No mechanical joint could withstand this service. The piping carries alternately refrigerating brine for freezing the skating surface and steam for melting it.

* * *

Milk storage tanks for a chocolate manufacturer were welded to prevent corrosion and unsanitary conditions. These tanks were fabricated entirely of stainless steel. They were welded to prevent corrosion at the seams as well as off-taste in the milk. The smooth, flush, inside surface left no pockets for chemical and bacterial action to produce spoilage.

* * *

A container for caustic soda solutions, made of Monel metal to resist corrosion, had a cast iron plug in the base. Corrosion troubles were imminent. By welding this and all other joints, corrosion was successfully prevented.

* * *

Tomorrow's engineers will be expected to know how to take advantage of this modern metalworking process. Many valuable booklets describing the oxy-acetylene process are available without obligation. For further information write any Linde office.

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THE CORNELL ENGINEER

PUBLISHED MONTHLY DURING THE COLLEGE YEAR

Volume 2 | APRIL, 1937 | Number 7

COMMENTS

, In "Smoke Abatement," Mr. Christy '11, M.E., Smoke Abatement Engineer of Hudson County, N. J., reveals causes and means of control of smoke. He stresses the need for education concerning the regulation of this evil, indicating the unique human elements involved.

* * *

Mr. Bissell '38, Arch., supplements the article by Mr. W. C. O'Connor '35, A.E., in our February issue on the "Aerodynamics of Sails." In his article "Balance 'On The Wind'," Mr. Bissell indicates the methods of analysis of sail area and design of rigging which have resulted from the latest studies of sailing.

* * *

Mr. Benjamin '38, M.E., is 'Johnny-on-the-Spot' with his article on modern methods of control in "Resistance Welding."

* * *

We extend our greetings to the Cornell Day visitors and offer the Program of the Engineering Show which we feel sure will be enlightening to all.

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Photo by Norman Herr '37

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Photo by Norman Herr

Welding In Freshman Laboratory

The
CORNELL ENGINEER

Volume II | April 1937 | No. 7

Smoke Abatement

By Wm. G. Christy '11, M.E.
Smoke Abatement Engineer, Hudson County,, N. J.

The making of smoke dates to the time primitive man learned the use of fire, and offensive black smoke probably first appeared with the discovery of bituminous coal in England. Originally coal was dug out from the seashore where it had been exposed by waves and tides and was called "sea-coal" to distinguish it from charcoal. It had come into widespread use in England in 1257. In that year Eleanor, wife of Henry III, removed to Tutbury Castle from Nottingham owing to the "unendurable" smoke of the sea-cole."

The earliest smoke-abatement association dates from 1306. It was in that year that the nobles and prelates coming to London were greatly annoyed by the increasing smoke and took the lead in getting up demonstrations. Despite the law of 1273, the situation became so bad that in 1307, King Edward I named a "Commission of Oyer and Terminer" to enforce the anti-smoke law. This commission's instructions are quite interesting: "To inquire of all such who burnt sea-cole in the city, or parts adjoining, and to punish them for first offense with great fines and ransoms, and for the second offense to demolish their furnaces."

The earliest English scientific treatise on smoke abatement seems to have been a small volume addressed to King Charles II in 1661 and published by his express command, entitled: "Fumifugium; or the Inconvenience of the Aer and Smoak of London Dissipated; together with some Remedies Humbly Proposed." The author was the famous diarist, John Evelyn, one of the founders of the Royal Society. He wrote:

> "That Hellish and dismal clowd of sea-cole . . . so mixed with the otherwise wholesome and excellent Aer, that her Inhabitants breathe nothing but an impure and thick Mist accompanied with a fuliginous and filthy vapour . . . corrupting the Lungs, and disordering the entire habits of the Bodies; So that Catharrs, Phthisicks, coughs and consumptions rage more in this city than in the whole Earth besides."

He proposed "that by an Act of Parliament this infernal nuisance be reformed." It was in 1795 that James Watt suggested that "cold fuel be introduced behind an incandescent mass." Known as the coking method, this remains today one of the best systems of hand firing bituminous coal.

The Smoke Problem

The elimination of smoke in any community is a combination problem. On the one hand it is highly technical and on the other it is an intensely human problem. The human part of the problem is the most important and by far the most difficult. Regulation of the discharge of smoke from chimneys is the professional engineer's responsibility. In the final analysis, it is a job for the mechanical engineer.

It Can Be Done

The technical features of the smoke problem have very largely been solved. Combustion engineering has kept pace with power generation, heating, and industrial operation. With very few and unimportant exceptions, any such operation can be carried on efficiently, economically, and smokelessly. Equipment can be designed to burn any fuel successfully and smokelessly. Not only can it be designed, but today there is on the market equipment which will burn almost any fuel and perform practically any operation without making smoke.

This is not a theory. Hundreds of instances can be cited where fuel burning operations are being carried on successfully, economically and smokelessly. The author is familiar with a large number of such operations in Hudson County, New Jersey. These comprise industrial plants, heating plants, railroad locomotives, steamships, tugs, ferries and incinerators. The fuels used include bituminous coal, oil, acid sludge, sawdust, shavings, tar, pitch, cocoanut shells, garbage and rubbish. In other words, *it can be done.*

This being the case, why are so many American communities still suffering from excessive smoke? Primarily, because of lack of good engineering advice. Other factors are ignorance, indifference, carelessness and inattention. To overcome these obstacles, and get the desired results, some one has to make it his business to see that

smoke laws and regulations are adopted and enforced.

Engineering Needs Publicity

For steam generation in stationary plants and for most industrial furnaces, engineers have designed and produced fuel-burning equipment which can be operated without smoke. The principal difficulty is that the public often does not realize that smoke abatement is primarily an engineering problem. The bulk of engineering work is not personal service, as is the case with the legal, medical, and other professions. Perhaps for this reason, and also possibly because engineers are often too reticent, the public does not have a very clear conception of engineers and engineering work. Probably the various engineering organizations, both national and local, as well as engineering colleges and technical schools, could improve this situation materially with more of the right kind of publicity. A well conceived and executed policy along this line should impart to the layman a better knowledge of our profession and its functions. Local engineering associations and local sections of national engineering societies ought to have active public-relations committees. The possibilities of what can be accomplished are evidenced by the results obtained by several such committees.

Industrial Boiler Plants

The most common source of smoke from boiler plants is the hand-firing of bituminous coal. The only satisfactory and permanent remedy is the installation of mechanical firing equipment. For the coals used almost universally in the East, the underfeed stoker is usually recommended. For the higher ash coals, such as those found in the Illinois fields, the chain or traveling grate stoker is best suited. Recommendations also include pulverized coal burners for almost any coal which can be handled satisfactorily in such equipment, and the general use of oil burners.

With any type of mechanical firing, furnace design and combustion space are important. We must always keep in mind that the three T's are essential to obtain complete combustion. By the three T's we mean Time, Temperature and Turbulence. We should make certain that provision is made for the three T's with the layout of every installation. Proper furnace design and ample combustion volume also will give longer life of refractories. When equipping existing boilers with mechanical firing equipment, it is almost always necessary to increase the combustion space. This usually means one of three things, raising the boiler, pitting the stoker, or building a Dutch oven.

In dealing with excessive smoke from an existing plant, a Department of Smoke Regulation often cannot get stokers or other mechanical fuel burning equipment installed. It is then necessary to resort to some kind of temporary expedient. The most common of these, and the one which usually gives best results, is the installation of steam-air jets. In the hand-fired boiler which smokes excessively, two of the essentials, Time and Turbulence, are partly or wholly lacking. Steam-air jets give a lot of turbulence, which helps to overcome the lack of furnace volume, or time element. It is important to have the right kind of jets, and to install them correctly.

The Human Element

At best, steam-air jets are more or less of a makeshift. Some plants equipped with them continue to smoke. There is still far too much dependence on the human element. The firemen object to the noise, or are careless and do not turn them on. Naturally, if the jets are not used, the plant smokes the same as before. Sometimes the boilers are heavily loaded, and set very low, in which case the jets will not eliminate smoke. About the only remedy for such a condition is a new boiler plant.

Care In Operation and Maintenance

No matter how well designed and modern the fuel burning equipment, men are still required to operate and maintain it. This is why the human element is so important. Whatever type of apparatus is used, skilled operators and experienced maintenance men are essential to insure that it function properly.

Service and maintenance can not be repeated too often or stressed too much. They are so frequently overlooked. Every item and part of fuel burning equipment should have periodic inspection. Cleaning, repair and replacements should be attended to immediately. This applies to valves, blowers, burners, motors, engines, gears, tuyeres, dead and dump plates, coal and ash conveyors, grinding mills, control apparatus, refractories, boiler heating surfaces, breechings, stacks, and instruments. If this were always done, smoke commissioners would have fewer gray hairs.

One reason for the smoky condition of many American cities is that the manufacturers and distributors of fuel burning equipment have paid too little attention to how it will be operated or to the fuel that will be used. The same applied to some producers and distributors of fuel. As a consequence, equipment is being installed every day which smokes from the time it is put in operation. In other words, in addition to the older plants which are now polluting the atmosphere, new ones are daily being added to the list of "Bad Smokers." This, of course, refers only to those districts where no permits are required and hence where there is no supervision of new installations by a smoke department.

Heating Plants

Heating boilers and furnaces were originally designed to burn anthracite coal. Nothwithstanding the fact that bituminous coal was the prevailing fuel used in large sections of the United States, heating boilers and furnaces of the same design were sold for use in these regions. For the larger heating plants, the down-draft boiler was developed for bituminous coal. In recent years, the so-called "smokeless boiler" was designed and marketed for soft-coal firing. Both of these types can be operated with very little smoke *provided* they are fired carefully. Here again the human equation is a big factor as boilers of these types will smoke if not given careful attention. Any such equip-

ment which depends on the proper functioning of the human element is never satisfactory from a smoke standpoint. Despite the newer designs mentioned, domestic heating boilers designed for anthracite are still being sold for hand firing with bituminous coal.

In much of the heating equipment still sold today, furnace volumes are much too small for bituminous coal or oil. There is insufficient or no provision for properly mixing the volatiles with air to get complete combustion. Most heating equipment gets far too little attention, due to ignorance and carelessness of operators, owners and superintendents. Many such people feel that, when they put in stokers or oil burners. their heating troubles are over. Any mechanical equipment requires service and maintenance.

In the case of apartments and other large heating plants, the caliber of the operators is not as high as it is in industrial plants. It is of the utmost importance that heating equipment should be as fool-proof as possible, and care should be used in the selection of fuel. Householders are indifferent or feel that the little smoke they make is just a drop in the bucket. In most of our eastern cities, anthracite coal has been the customary fuel used. In such regions it is only natural for Departments of Smoke Regulation to recommend anthracite coal or coke for heating plants using solid fuel.

Railroads

In most American cities, the railroads are a large factor in the smoke problem. While most of the larger locomotives are now stoker fired, switch engines and many used on local trains are still hand fired. Many of the Eastern roads still have in service engines with fireboxes designed for anthracite coal. There are devices, including air-induction tubes, ring blowers, and special grates which are of great assistance in getting better combustion. Elimination of railroad smoke depends to a considerable extent on the human element. Quite a number of men have a part in handling a locomotive at different times during its cycle of operations. The master mechanic and his force of mechanics take care of all repairs and maintenance. A fire builder, under supervision of an enginehouse foreman, builds the fire. Very often a water tender looks after the engine before it is moved out of the round house, this latter being done by a hostler. There may be an engine watchman who keeps up steam until the crew comes aboard. After the run there may be fire cleaners, fire knockers, hostlers, and water tenders having a hand in taking care of engines.

Notwithstanding that a locomotive is a moving power plant, with high rates of combustion and a rapidly varying load, that the crews have strict time schedules to meet, numerous signals and crossings to watch in addition to all duties of power-plant operation, that there are stringent requirements of the roads themselves and of numerous regulatory bodies, and hundreds of laws and ordinances to be observed, the railroads usually do a better job of smoke abatement than other classes of plants.

Regulation

The author cannot too strongly emphasize the human element in smoke abatement work. No matter how good fuel and equipment are, how well the plant is designed, we still must depend on men to operate it. There is a certain amount of psychology in smoke prevention work. Experience has shown that best results are obtained when plant executives and operators realize that someone may be watching their stack at any time. The presence of smoke inspectors in the field has stopped a lot of smoke. Smoke consciousness instilled into men's minds is undoubtedly one of the greatest factors in this work. This is really a problem in mass education. Publicity of all kinds is of material assistance.

The author has left to the last what he believes to be the most important part of smoke regulation, namely permits for all fuel burning equipment. Without such regulations, new smokers might be added to the list every day. Due to the intense competition in the sale of fuel and equipment, it is only natural that little attention is paid to smokelessness, unless there are laws and regulations in effect. With hundreds of smoking chimneys to contend with, it would seem foolish to allow new ones to be installed. Since the Hudson County smoke department was organized, early in 1931, approximately 12,500 permits have been issued to install new fuel burning equipment. If there were no regulations, this would mean that there would be eight potential smokers added to the list every day. The smoke ordinance and regulations should apply to every fuel burning plant, including private residences. We endeavor to incorporate in these regulations our best judgement, based on experience and a knowledge of combustion engineering.

A Major Problem

The necessity for constant vigilance must be emphasized. Smoke abatement is the type of job that someone has to keep at continually. Why have so many smoke abatement campaigns failed? It usually is due to the fact that people think of the problem in too small terms. They are inclined to think of smoke abatement as furnishing two or three jobs for inspectors at City Hall. The elimination of smoke is a major community problem, comparable with maintaining our streets, and keeping our water supply pure. All too often, when there is a cry for economy, the smoke department is one of the first to suffer. There were many examples during the past few years. Several cities have made commendable records in eliminating smoke, and then have felt the job was accomplished. Smoke bureaus have been discontinued or greatly curtailed. Usually, within a few months, the results of several years' efforts are lost. Municipal water departments continue from year to year as a matter of course. Even with changes of administration and economy programs, the engineers are kept on the job and the water department functions. The American public needs to be convinced that pure air is as essential as pure water and that the job of maintaining pure air is just as important.

Courtesy of Rudder

Six-meter Indian Scout—Outstanding In International Competition

Balance 'On The Wind'

By Nicol Bissell '38, Arch.

Although yacht racing has become one of the most popular sports in the country, there are very few yachtsmen who stop, in their enthusiasm to reach the starting line, to consider just what forces are making their boat behave as she does. How often one hears some "old timer" boast of a sudden burst of speed acquired in his one design because he shifted his mast or moved his ballast. I could cite numerous examples of men who have sailed and raced for years and who now play certain tricks on their boats—having discovered them only after bitter experience or pure chance. Many yachtsmen have been scared away from the theories governing a sailboat because many facts and formulae seemed too complicated to master. Certainly no one would attempt to solo an airplane without acquainting himself somewhat with the theories of aeronautics or even without some knowledge of what makes a propeller revolve. Should it not be that sailing be put on this same scientific basis?

Text-books on naval architecture are numerous and are available and enlightening to any amateur sailor with a knowledge of the fundamental laws of physics and mechanics. Most yachtsmen never intend to design a boat themselves and, consequently, have steered clear of all technical articles and discussions. They trust in their past experience and good luck to pull them through successfully. It is not the intention of the author to summarize in simple terms all the factors in naval architecture—that would be well nigh impossible—but it is his intention to point out a few of the basic principles that govern a fascinating problem in sailboat design:—the question of balance.

One of the objects in tuning the rigging before a race, or adjusting the sails and ballast during a race, is to acquire better balance. Being one of the few guides that a helmsman has in determining whether or not his boat is sailing at a maximum, balance is all important. If a boat is well designed and handled, it should, under normal conditions, sail by itself. That is to say, there should be no excessive "weather helm" or tendency to go to the wind, and no excessive "lee helm" or tendency to fall off from the wind.

A boat may be well handled, and designed by the most experienced architect, yet she may still be unbalanced. No boat sails exactly the same from day to day because conditions change. Every yachtsman should be on his toes, anticipating the forces at play and working every minute to acquire just a little more speed. The author can remember very vividly sailing in, after a hard fought race, to be greeted by the familiar phrase, "My boat just wouldn't move today."

Because of a bad setting sail or a rough bottom, this kind of an alibi often has grounds, but on this particular day we were sailing in a well matched Atlantic Class fleet, and if my defeated friend had cooled down in the excitement of sailing his boat through the water, he would have noticed that his jib had been continually flapping on the windward beat. He had forgotten that balance was just as important as smacking each wave correctly and had, consequently, spent most of his energy fighting a strong weather helm.

Balance is governed by the relation of two factors, namely: The Center of Lateral Resistance of the hull and The Center of Effort of the sail. Before we discuss how each of these factors is determined, let us stop and consider just what effect each has on balance.

The Center of Lateral Resistance is the point where the water pressure is theoretically concentrated. If it were possible to place the Center of Effort on a vertical axis through this point, there would be no tendency to rotate about the Center of Lateral Resistance. This, then, would be perfect balance. But when the Center of Effort moves aft in relation to the Center of Lateral Resistance, a moment is created and the boat tends to go into the wind. The opposite effect is true if the Center of Effort is forward of the Center of Lateral Resistance.

The Center of Lateral Resistance is the center of the total immersed portion of the hull. Its exact position is indeterminant, as it is constantly changing due to the following conditions:

1.—The actual shape of the lateral resistance, and consequently its center, often moves as the boat heels and gains speed. This is particularly true of beamy, shoal-draft boats where the center shifts forward causing a weather helm, and resulting in a loss of speed due to the force needed to counteract this by the rudder.

2.—The bow wave and its pressure created on the lee side tends to throw any accurate calculation of the Center of Lateral Resistance off.

3.—As the leading edge of the lateral resistance is constantly meeting firm water, the forward part of the underwater section offers more lateral resistance than the after part.

4.—As the boat heels, and the Center of Effort of the sails moves to leeward from its original vertical position, a moment is created which tends to force the boat into the wind. In Fig. 1, "E" is the effective force of the wind, "D" is the distance between the vertical planes of the Center of Lateral Resistance and the Center of Effort. As the wind increases, both D and E increase, resulting in a greater moment about the approximate Center of Lateral Resistance.

In view of these variables, and several others, it is obvious that the best we can do is to approximate a center of resistance by determining the Center of Lateral Plane and realizing that this point must lie within certain limits.

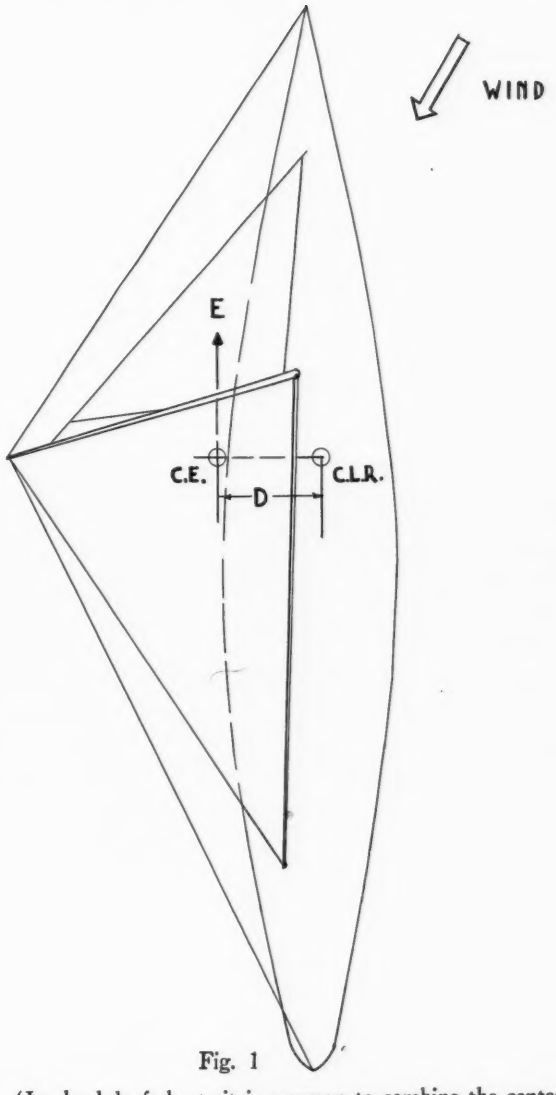


Fig. 1

(In shoal-draft boats it is common to combine the center of bouyancy with the center of the center-board area in estimating the Center of Lateral Resistance.) Experience has shown that a distance of 55 to 59 percent of the water-line aft from the bow at the water-line is the most satisfactory. In the design of a six-meter, which we will sketch through briefly during our discussion of the relationship between the Center of Lateral Plane and the Center of Effort, a distance of 56% of the 23 foot waterline was chosen. In Fig. 2, this is shown as "S" or 12 feet 9.6 inches.

For determining the center of the underwater portion, Simpson's Rule may be used when the contours are regular. In most cases, however, they are not regular, and the usual practice is to cut the exact shape of the area out of paper or cardboard and determine its Center of Gravity. This, it will be remembered, when projected to the waterline is not the true Center of Lateral Re-

sistance, but an approximation of it, called the Center of Lateral Plane. Two methods are used in computing this. The first consists of suspending the irregular area from two or more points near any edge and marking the plum line intersections. Another method is to fold the paper shape over several times parallel to the water line. By balancing the resulting strip on a knife edge, the line along which the Center of Gravity must lie can be determined.

After the Center of Gravity or the Center of Lateral Plant is determined, the next step is to relate this to the center of the sail area or the Center of Effort, because the nearer these two forces fall in line, the more perfectly the boat will balance. Before we calculate the position of the Center of Effort, which is a comparatively simple problem, let us first determine approximately how much area of sail we need. Many graphs have been drawn with reference to sail area, water-line, and displacement. These charts are valuable as a means of comparison in that they establish certain limits. But the use of the boat and its proposed sailing environment play such an important part that if we merely bear in mind the following relation, we may arrive at a rough estimate. The heeling moment must equal the righting moment.

In analyzing these two factors, we see that the heeling moment is the pressure tending to tip the boat, created by the wind multiplied by the actual vertical distance between the Center of Effort and the Center of Lateral Plane. The pressure on the sail is generally computed for a good strong wind, about 1.15 pounds per square

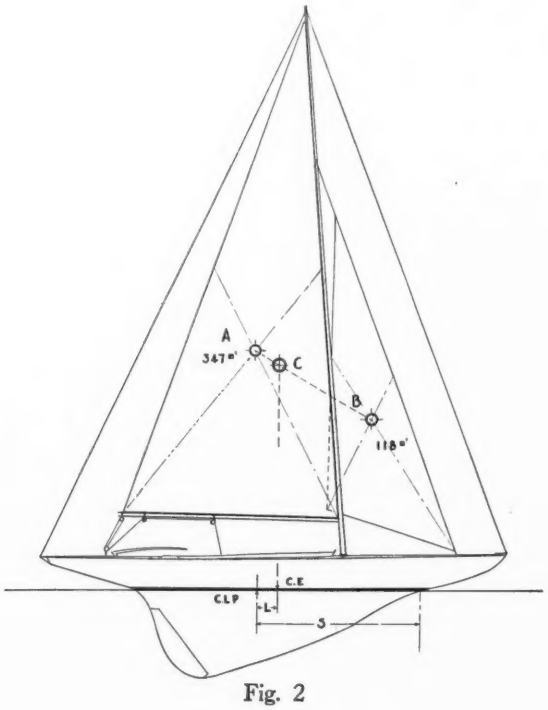


Fig. 2

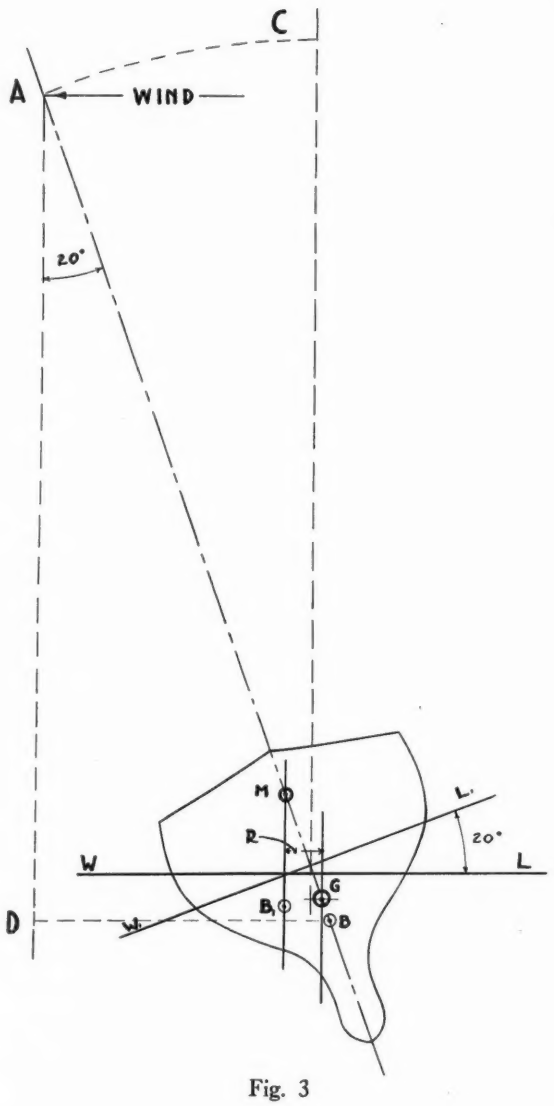


Fig. 3

foot. The righting moment is equal to the displacement times the Righting Arm. The latter term, the Righting Arm, can be analyzed as follows: Fig. 3 shows the six-meter hull heeled at an angle of twenty degrees with the horizontal. The actual displaced water being the same in the heeled position as in the erect one, WL and W_1L_1 mark the new and old positions of the water line. "G" marks the Center of Gravity, "B" the original Center of Buoyancy and "B_1" the new Center of Buoyancy. The Righting Arm is the perpendicular distance "R" between a line drawn from "G" perpendicular to the waterline and the line drawn parallel to this through "B_1". This latter line, B_1M, intersects the centerline at a point M known as the transverse metacenter. G.M. is the metacenter height, and we can compute the Righting Arm as being G.M. sin 20 degrees. It is sufficient to

state that the Righting Arm for the six-meter, at an angle of 20 degrees, was found to be 1.27 feet. To solve the equation, heeling moment equals righting moment, we now have only one unknown,—the sail area. From Fig. 3, we can see how these two moments can be graphically analyzed.

The height of the Center of Effort above the Center of Lateral Plane was taken as 20.2 feet and is designated by Point C. This distance decreases to AD as the boat heels, varying with the cosine of the angle.

$$AD = \text{Cos } 20^\circ \times 20.2$$
$$\text{Cos } 20^\circ = .94$$

For the design of the six-meter, the displacement was 8,000 pounds. Equating the heeling moment and the righting moment, and letting A equal the sail area:

$$1.15 \times A \times .94 \times 20.2 = 8{,}000 \times 1.27$$

Solving for A, we find the sail area equal to 465 square feet.

When the area is determined, it can be broken up into as many parts as desired and a sail plan designed independent of the hull. For our purposes, let us break the total area into two parts, in a one to three ratio, giving the mainsail 347 square feet and the jib 118 square feet. In Fig. 3 we see the two triangles laid off to these areas and their centers determind by bisecting the opposite sides. Their combined center can be considered the Center of Effort of the sail plan, although the actual Center of Effort is again indeterminant, lying somewhat further forward. This total Center of Effort must lie on a line AB connecting the centers of the jib and mainsail and its distance from B can be computed by taking moments about B. This locates the Center of Effort in respect to the two triangles.

The distance between the projected Center of Effort at the water-line, and the Center of Lateral Plane can be thought of as a certain percent of the water-line length. This percent, or lead of the Center of Effort forward of the Center of Lateral Pressure, varies with the type of hull from 3 to 8. In designing the 6 meter, a lead of 6% of the water-line was used or sixteen and one-half inches. This is marked in Fig. 2 as the distance "L".

Thus we see that balance is not entirely a guessing game in the sense that many yachtsmen think of it. After the naval architect has designed and delivered a boat, part of the job of ownership is the attempt to perfect the design by applying a practical knowledge of the forces that are present. Any adjusting of rake or ballast, or any of the acquiring of new sails should be based upon knowledge of the mechanics of sailing.

Resistance Welding

By David Benjamin '38, M.E.

For a great part of its comparatively short life, resistance welding was a hit or miss affair. Results were not accurate, or consistent, and the apparatus was not entirely dependable. Recently, several methods of control have been developed, which give high quality results, and which have reduced the number of faulty welds to a small fraction of what it had been.

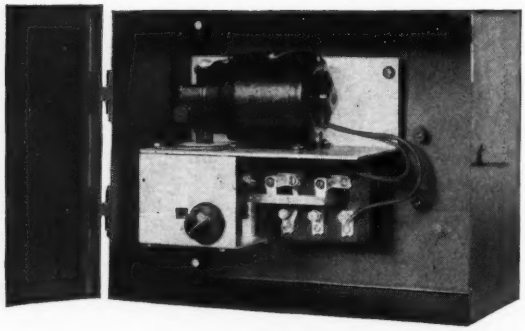
Resistance welding may be found as spot or seam welding. In the former case, the two pieces of metal undergoing fabrication are joined at one or more places by a "spot" of relatively small area. A seam weld is a series of spot welds, each overlapping the preceding one. Two pieces of metal which are seam welded are joined along a line, and are more nearly water-, gas-, or steam-tight, than they would be were they merely spot welded.

Resistance welding, in either of these two forms, has found a large commercial application because it is economical, of high quality, and adapts itself to a higher degree of control than is usually found in other types of welding. The controllability is the outstanding recent development in this type of welding, and will be the principle subject of this discussion.

Spot Welding

The principles involved in spot welding are simple. Two electrodes are pressed against the two pieces of metal to be welded—one on either side—pressure is applied, and current is passed from one electrode to the other. The effect is very similar to a high grade forged weld, due to the pressure. When the current flows, heat appears in the metals undergoing welding. The heat is proportional to the square of the current, and proportional to the resistance, and also the time during which the current is allowed to flow. Thus the greatest amount of heat is generated at the surfaces where the two pieces of metal are in contact, for here is the region of highest resistance. The pressure exerted by the electrodes gives the forging effect to the weld.

The electrodes are generally water cooled, to avoid undue heating. For the same reason, they are made of a low resistance material, usually copper, and are of rather large cross section, except at their very tips. The ends of the electrodes taper to a smaller cross section in order



—*Courtesy General Electric*

Spot-welding Timer for Control of Contactor Coil Current

to apply high pressure to the work. This pressure is necessary for a satisfactory weld, for the surface resistance of the pieces to be welded is too high to allow the flow of a large current unless the surfaces are pressed firmly together. The smaller the region of high pressure between the surfaces of the metals, the greater the current density at that point, and consequently the less the time required to generate enough heat for a satisfactory weld.

There are two methods frequently used for applying pressure to the work, and a third, which is a combination of both. One electrode is stationary, and the other moves. The movable electrode may be controlled by compressed air, by cams and levers, or by both systems.

In the pneumatic system, compressed air is admitted into the cylinder fitted with a piston, to which is attached the moveable electrode. Air is admitted to the cylinder, causing the electrode to descend on the work until the proper pressure is attained, the air supply is checked, and the current turned on. The advantages of this system are that the pressure is easily adjusted by means of an air gage and reducing valve. The disadvantage is that for high speed welding, the air must be at high pressure, and the electrode gives more or less of a hammer blow to the work. Satisfactory welds can be made at a speed of 20 to 30 welds per minute, when the pneumatic system is used.

When the electrode is cam operated, a spring return is used. The use of cams allows the electrode to be highly accelerated until it is near the work, when it can be slowed up, to strike the work easily. More welds per minute can thus be attained. This system, however, is not as easily controlled from the pressure standpoint as is the pneumaticly operated machine.

A combination of both the pneumatic and the cam drives gives the advantage of the pressure control of air, and the high speed of the cam operation.

Seam Welding

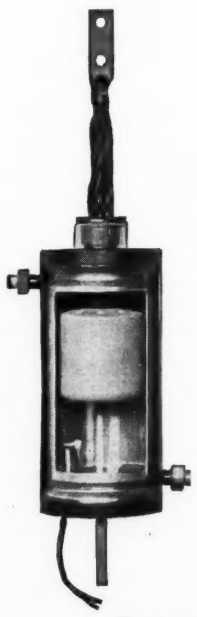
Seam welding is similar in principles to spot welding. Rotating discs are used as electrodes in place of the pointed electrodes for spot welding. The peripheral velocity is about 72″ per minute. Usually the discs are cooled by flooding them with water.

It has been found necessary to interrupt the current as the work travels, in order to obtain a good weld. This interruption of current gives the effect of a series of overlapping spot welds, rather than a continuous weld. There are two reasons for breaking the current:

1. If the current were uninterrupted, there would be a continued rise in temperature, and both the work and the electrodes would be in danger of being ruined by the heat.

2. There are always discontinuities in the surface resistance of the pieces of metal undergoing welding. If the current were not interrupted, there would always be a pool of fluid metal in the wake of the rotating welding discs. This molten metal has good conductivity for electricity, and when the discs come to a position of the work where the resistance is higher than average, the current would detour around that spot, to the molten metal behind the electrodes, leaving that particular section unwelded. By interrupting the current, the metal behind the electrodes solidifles before the next impulse.

(*Continued on page one hundred sixty-one*)



—*Courtesy General Electric*

New 200-Amp Water Cooled Ignitron for Welding Control. Double-wall Envelope Partly Removed.

1 • 9 • 3 • 7

ENGINEERING SHOW

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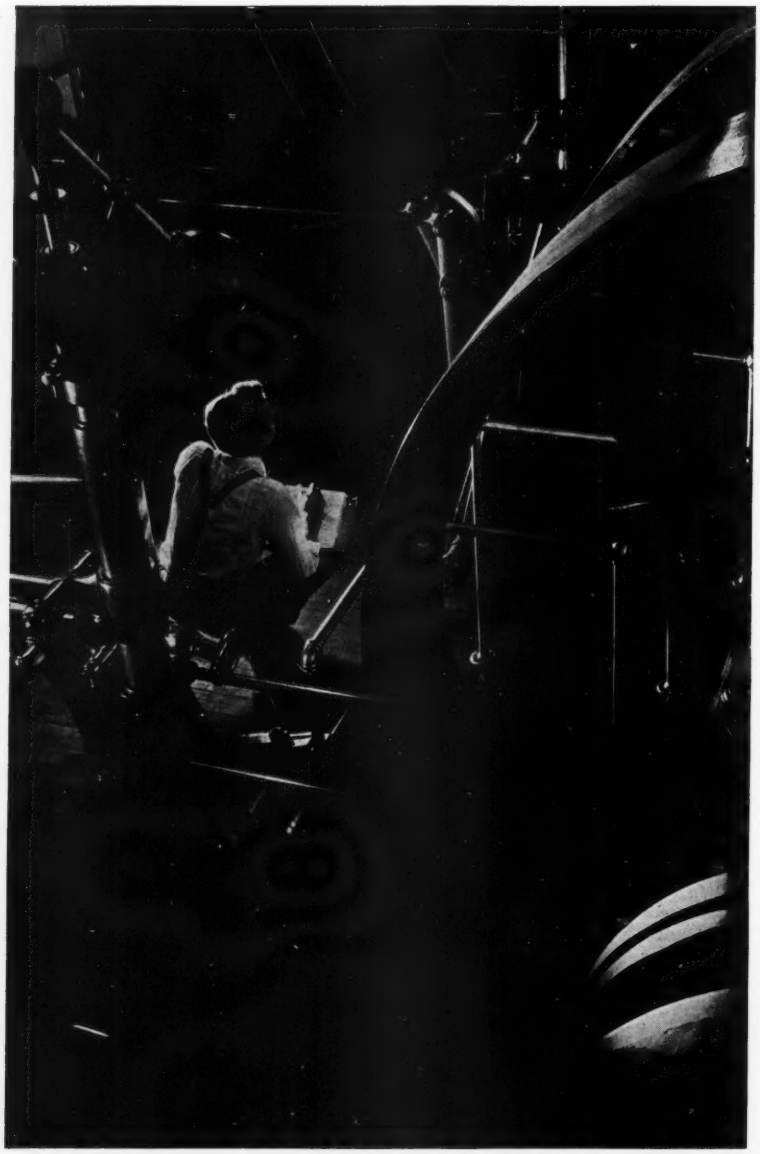
ON the evening of Friday, April 30, and again on Saturday, May 1st, the College of Engineering will again keep Open House for its home-coming alumni, students, and prospective students in celebration of Cornell Day. Once more students and faculty are cooperating to devise a series of exhibits to illustrate the regular work of the college as well as the recent advances in science through research, made either at Cornell or elsewhere. The program of these exhibits follows. It is hoped that ever increasing numbers of alumni will take advantage of this "show", both for the purpose of keeping abreast of new developments in Engineering, and incidently to note how these advances are made a part of the regular instruction. To prospective students the exhibits offer a fine opportunity to become acquainted with the various sub-divisions of the broad engineering field.

To both alumni and prospective students, the College of Engineering hereby extends a special invitation for the Cornell Day of 1937.

H. DIEDERICHS
Dean, College of Engineering



Photos by Norman Herr '37

Compound Corliss Steam Engine—Mechanical Laboratory

Mechanical Engineering

Sibley College

GEAR CUTTING IN RAND HALL

A gear blank of cast iron is placed beneath a rotating formed cutter in this horizontal milling machine. The profile of the cutter corresponds to the shape of the space which is to be cut between the teeth of the finished gear.

Exhibits

Friday Evening and Saturday Morning

West Sibley
HEAT POWER
- Model stoker
- Model power plant
- Turbine and steam engine models
- Student drawings
- Valve gear models
- Slide rules

MECHANICS
- Photoelastic laboratory

Freshman Laboratory
MECHANIC ARTS
- Metallizing
- Oxygen metal cutting

Rand Hall
MECHANIC ARTS
- Automatic screw cutting machine
- Machine tools
- Pattern shop

Sibley Dome, Recreation Room
MISCELLANEOUS
- Wiggly block test
- Advertising
- Marketing
- Air conditioning
- Machine design
- Industrial

West Mechanical Laboratory
AUTOMOTIVE
- Gasoline engines
- Brake models
- Transmission and differential gear

AERONAUTICS
- Wind tunnel
- Model airplanes

MECHANICAL LABORATORY
- Doble water wheel
- Compound Corliss steam engine
- Air compressor
- Troy steam engine
- Gas engine
- Belt testing machine
- 150 horsepower steam boiler

East Mechanical Laboratory
MATERIALS
- Materials testing
- Heat treatment

METALLURGY
- Metallograph
- Microscopic examination of metals
- Microprojection of organic melts

MECHANICS
- Balancing machine

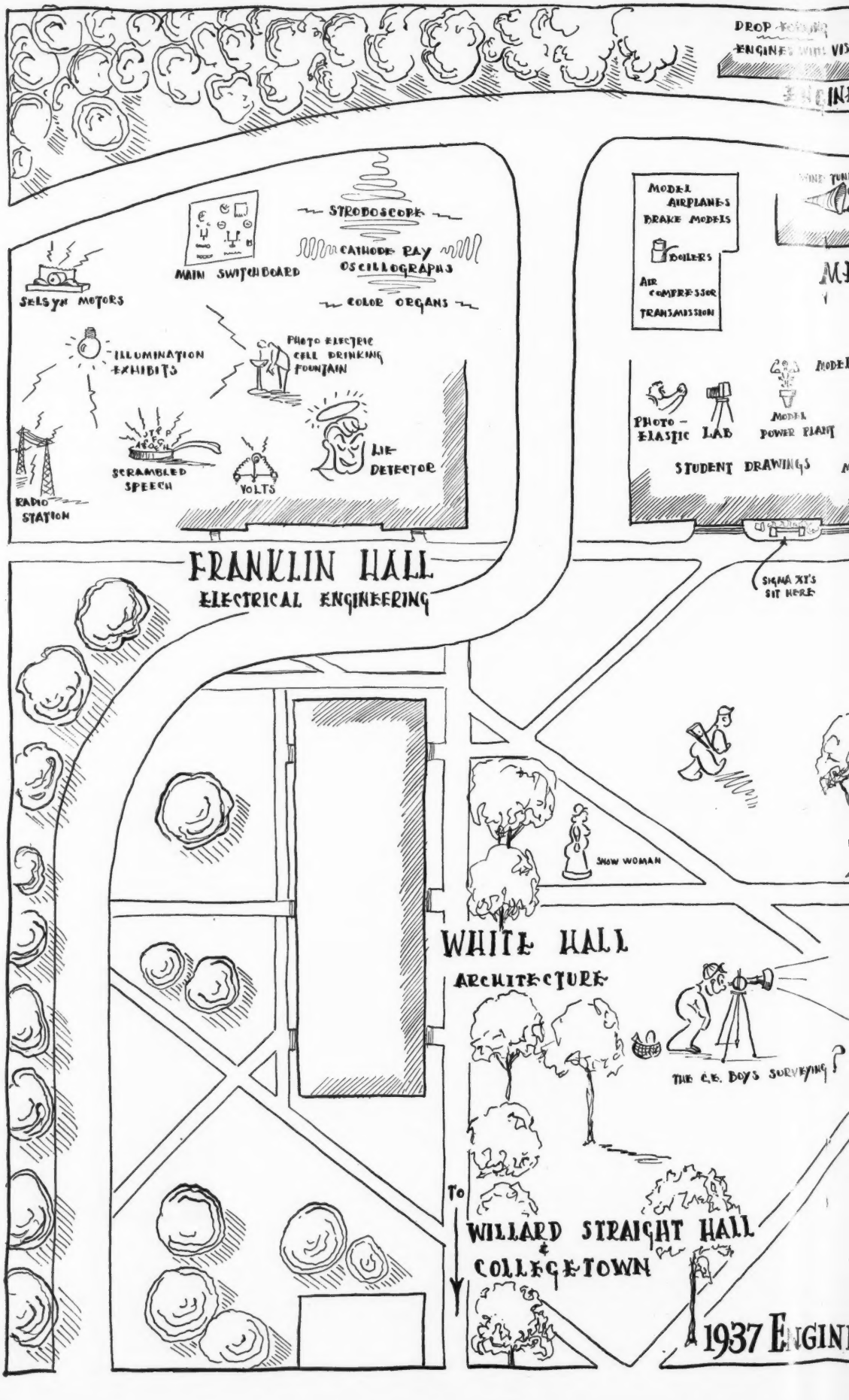
This year, for the second time, the Sibley School of Mechanical Engineering presents an exhibition, wherein the work of the school and its students will be demonstrated by interesting and spectacular exhibits. Performances will be given on Saturday morning for the sub-freshmen, and on Friday evening for the alumni, students and visitors.

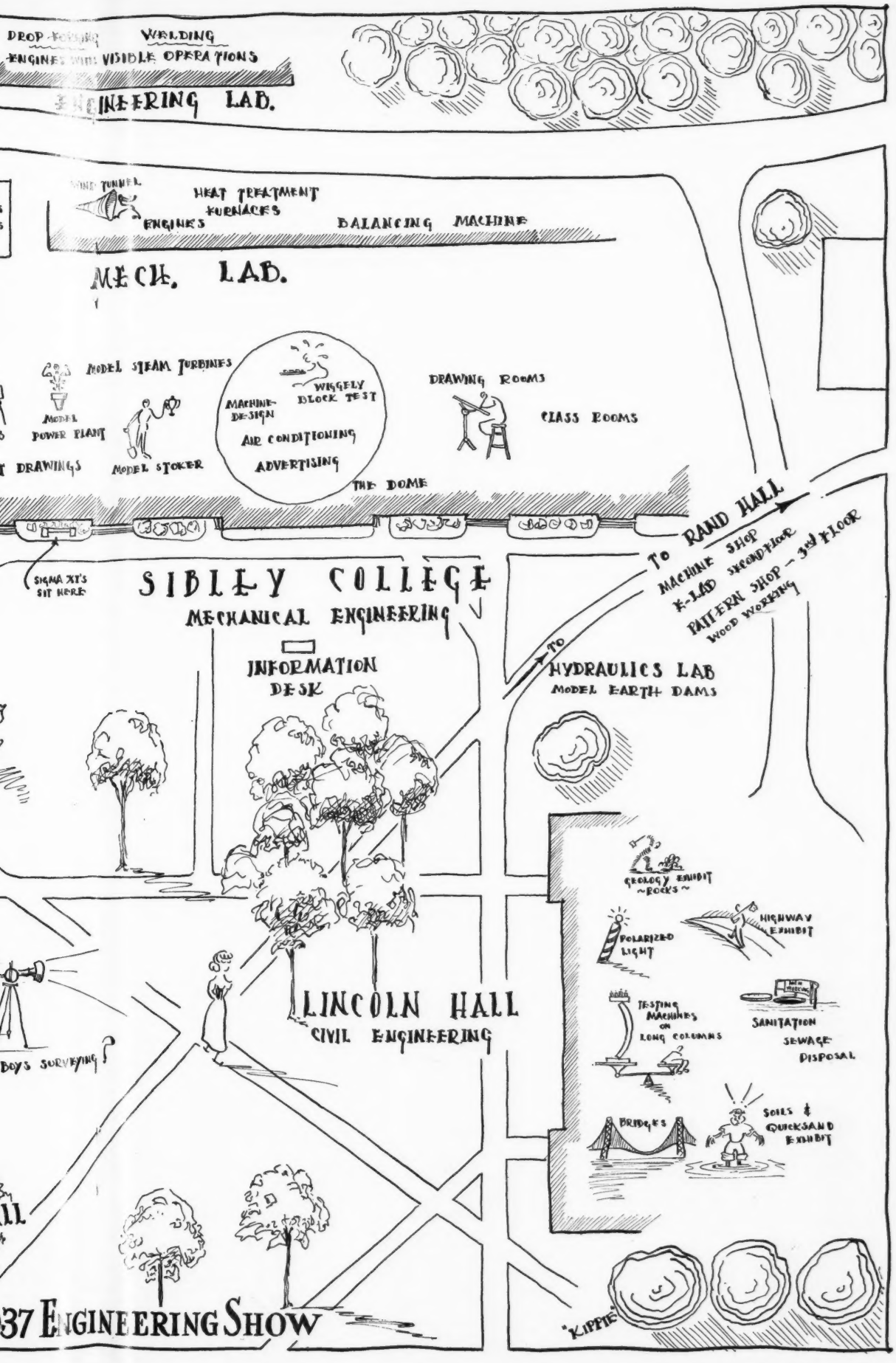
The exhibits, each taken from a department in Sibley College, will present the various aspects of the wide range of the field of Mechanical Engineering. From Automotive Engineering, demonstrations of engines, brake models, and transmissions and differential gears will be made. In the field of aviation a wind tunnel and model airplanes will be in operation, and a test performance will be carried on. The Heat Power Engineering Department will exhibit a large working model of a Westinghouse stoker, a complete model power plant, model steam engines operating under steam, and other apparatus and charts pertaining to power plant work. The Industrial Engineering exhibition will offer a demonstration, showing how a time study is made, a factory layout, jigs and fixtures built according to the results of time and motion studies, and, in addition, will show movies of motion economy. An interesting display of odd-shaped gears, belt models, and other kinematic devices, from the College's museum, will illustrate the field of machine design. These models are a part of the only complete set in the United States. Student drawings, part of the drafting room work of Mechanical Engineering students, will accompany the exhibit.

The Mechanical Laboratory will have tension, torsion, compression and transverse material tests. There is a show of heat treatment furnaces, a compound Corliss steam engine, gas engine, air compressor, and many other pieces of machinery and testing apparatus in operation. Of particular interest this year, will be the automatic screw machine, along with the other equipment in the machine shop, metallizing and oxygen metal cutting in the Freshman Laboratory, and the model house of the summer and winter air conditioning display.

TAPPING MOLTEN CAST IRON FROM CUPOLA FOUNDRY

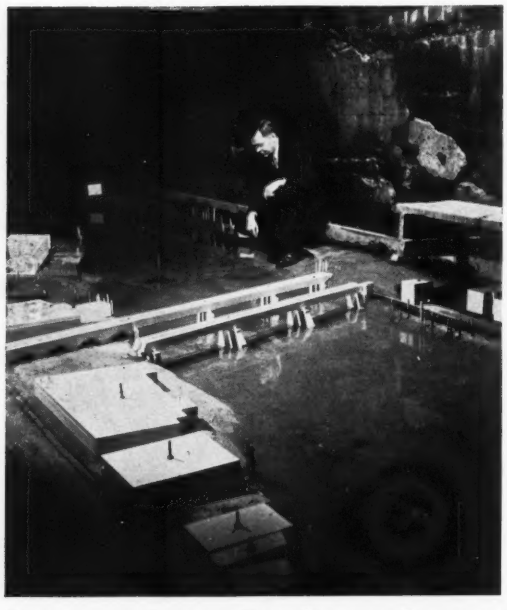
The worker has just pulled a clay plug out of the bottom of the cupola. The cast iron can be seen, running into a ladle, from which it will be immediately poured into sand molds.


STRODOSCOPE
MAIN SWITCHBOARD
CATHODE RAY OSCILLOGRAPHS
SELSYN MOTORS
COLOR ORGANS
ILLUMINATION EXHIBITS
PHOTO ELECTRIC CELL DRINKING FOUNTAIN
SCRAMBLED SPEECH
VOLTS
LIE DETECTOR
RADIO STATION
MODEL AIRPLANES
DRAKE MODELS
BOILERS
AIR COMPRESSOR
TRANSMISSION
PHOTO-ELASTIC LAB
MODEL POWER PLANT
STUDENT DRAWINGS
SIGMA XI'S SIT HERE
FRANKLIN HALL
ELECTRICAL ENGINEERING
SNOW WOMAN
WHITE HALL
ARCHITECTURE
THE C.E. BOYS SURVEYING
To
WILLARD STRAIGHT HALL
&
COLLEGETOWN
1937 ENGIN


WELDING
VISIBLE OPERATIONS
INEERING LAB.
WIND TUNNEL
HEAT TREATMENT FURNACES
ENGINES
BALANCING MACHINE
MECH. LAB.
MODEL STEAM TURBINES
MODEL POWER PLANT
DRAWINGS
MODEL STOKER
MACHINE DESIGN
WIGGELY BLOCK TEST
AIR CONDITIONING
ADVERTISING
THE DOME
DRAWING ROOMS
CLASS ROOMS
TO RAND HALL
MACHINE SHOP
M-LAB SECOND FLOOR
PATTERN SHOP - 3rd FLOOR
WOOD WORKING
SIGMA XI'S SIT HERE
SIBLEY COLLEGE
MECHANICAL ENGINEERING
INFORMATION DESK
TO HYDRAULICS LAB
MODEL EARTH DAMS
GEOLOGY EXHIBIT ~ROCKS~
POLARIZED LIGHT
HIGHWAY EXHIBIT
TESTING MACHINES ON LONG COLUMNS
SANITATION SEWAGE DISPOSAL
BRIDGES
SOILS & QUICKSAND EXHIBIT
LINCOLN HALL
CIVIL ENGINEERING
BOYS SURVEYING
"KIPPIE"
37 ENGINEERING SHOW

Civil Engineering

Lincoln Hall and Hydraulic Laboratory



MODEL OF THE CHENANGO DAM—HYDRAULIC LABORATORY

Director Hollister of the College of Civil Engineering inspects a scale model of the Chenango River Valley and dam. The model was built for the purpose of making flood control tests.

The modern field of Civil Engineering demands a thorough knowledge of the fundamentals of design and practice. These fundamentals are unchanging, but are constantly being augmented by the results of further research and new technique. Schools of Civil Engineering today must constantly train the engineer of tomorrow for his mastery of the basic principles, as well as present the more recent details of practice selected from the results of modern research and experience.

Present day engineering is making a fuller use of the laboratory than has been done for some years. The student can learn much from actual observation and recording of data from tests on commercial materials and products. This exhibit is therefore primarily of a laboratory nature, so that you may carry away a more accurate picture of the modern engineer's background.

In the materials laboratory, the engineer tests the materials he is to use in his structures (concrete, wood, steels, glass, stone, brick, and others). It is here that he verifies his design and selects the most economical and the strongest shapes for the members of his structures.

It is only recently that the engineer has taken up the study of the mechanical properties of the soils upon which his structures rest. The results of laboratory investigations have done much to augment and improve the recent design of foundations, earth dams, roadbeds and the like.

The works of the sanitary engineer are not seen ordinarily. Most of his projects are underground, or remote from the daily haunts of men. But to him we owe much of our present health and happiness, for his is the job of purifying the water and disposing of the sewage and garbage of the cities we live in.

At the Hydraulics laboratory you may see the preliminary steps in the design of various flood control projects (earth dams, dikes, masonry dams) as well as the labyrinth of pipes used by the haudralic engineer in developing water supplies, irrigation systems, fire protection, and hyroelectric plants.

Exhibits

Friday Evening and Saturday Morning

Materials Testing
Sewage Treatment
Soils Testing
Structural Engineering
Drawing and Design
Surveying Practices
Highway Engineering
Hydraulic Engineering
Railroad Engineering
Geology and Astronomy
Research Developments

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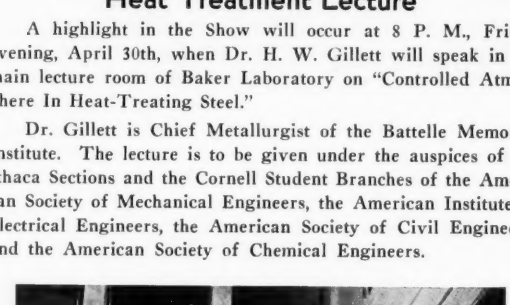
Heat Treatment Lecture

A highlight in the Show will occur at 8 P. M., Friday evening, April 30th, when Dr. H. W. Gillett will speak in the main lecture room of Baker Laboratory on "Controlled Atmosphere In Heat-Treating Steel."

Dr. Gillett is Chief Metallurgist of the Battelle Memorial Institute. The lecture is to be given under the auspices of the Ithaca Sections and the Cornell Student Branches of the American Society of Mechanical Engineers, the American Institute of Electrical Engineers, the American Society of Civil Engineers, and the American Society of Chemical Engineers.

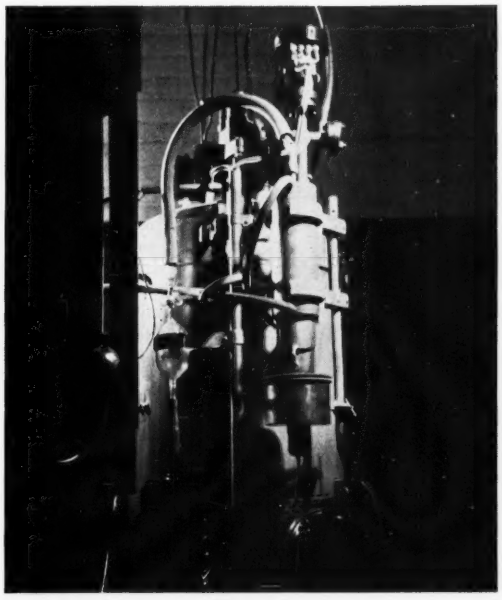


SOUTHWALK TESTING MACHINE, 3000.000 POUND CAPACITY

Testing a diamond shaped butt-strapped welded connection in tension in the materials testing laboratory, Lincoln Hall.

Electrical Engineering

Franklin Hall



LARGE MERCURY ARC RECTIFIER

This water cooled tube, made by Allis Chalmers, is capable of handling forty amperes, at 250 volts. Three grids and three anodes provide extreme flexibility.

With an ancient heritage behind it, the Electrical Show should be one of the most interesting ever produced on this campus. However, the ME's and the CE's, with their more recently organized shows, do not intend to allow the Electrical Engineers to rest upon past laurels.

The extremely notorious "lie detector" will be shown for the second time, in a new and improved form. It will reveal the vile knavery of visiting prevaricators. An electric gun will satisfy the desires of visiting sportsmen and gangsters, while he-men will be able to demonstrate their brute strength to feminine admirers on the electric manpower machine. Dry visitors can conveniently quench their thirst from the photo-electrically operated drinking fountain.

A half hour of brilliant entertainment is promised in the auditorium, with a surprising exhibit of acoustical effects. Nightmares of the electric transmission engineer will be shown by the lightning generator and the climbing arc. Wierd color schemes are promised, and speech will be transmitted on a beam of light.

You will hear your own voice, as it sounds on the telephone—it's not quite the same as you will expect it to be. But you will not be able to recognize your own, or anyone else's voice after it has been through the speech scrambler.

Amateur radio, recently developed into a great national hobby, is represented with a complete modern installation. Radio remote control will place familiar devices at your command, without any physical connection to the device itself.

In addition, there will be an exhibit of electric cooking. This will be done on a high frequency oven, into which you can put your hand, and feel no heat, but in which metals will melt. You will see Selsyn motors that provide coördination by electrical means; gaseous discharge tubes; photocells, for translating light energy into electrical, and ultimately into mechanical energy; thyratrons, handling large currents; and high voltage phenomena. An interesting and instructive exhibition is promised the visitor to the 1937 Electrical Show.

Exhibits

Friday Evening and Saturday Morning and Saturday Evening

- Sound Movies
- Photo-cell Counters
- Jumping Rings
- Eddy Current Cooking
- High Frequency Analyzer
- Transmission Line Vibration
- Smoke Precipitator
- Low Pressure Discharge
- Tesla Coil
- Kinetoscope
- Electronic Alarm
- Scrambled Speech
- Color Organ
- Radio Remote Control
- Amateur Radio Station
- Electric Gun
- Three Phase Exhibit
- Magnetic Brake
- Breath Relay
- Lightning Generator
- Climbing Arc
- Oscillograph
- Stroboscope
- Lie Detector
- Beam Casting
- Color and Illumination
- Selsyn Motor Demonstration

CATHODE-RAY OSCILLOSCOPE

With the aid of this device, the Electrical Engineer obtains a visual picture of the shape and relationship of voltage and current waves.

CORNELL UNIVERSITY
I WOULD FOUND AN INSTITUTION WHERE
ANY PERSON CAN FIND INSTRUCTION IN ANY STUDY
FOUNDED BY EZRA CORNELL

(*Continued from page one hundred sixty*)

CONTROL

The variants which affect the character of a weld are the electrodimensions, the rate of cooling, the surface conditions of the metals, the character of the current wave, and the timing of the current for the weld. The last two are not subject to control by ordinary methods, but depend on special control apparatus, including synchronous motors, thyratron tubes, and ignition tubes.

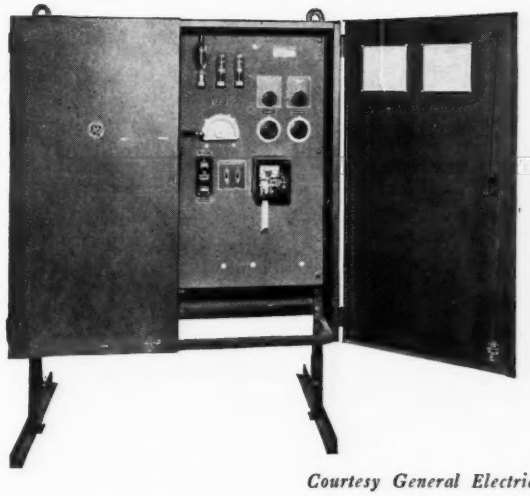
Since the heat developed in welding is proportional to the square of the instantaneous value of the current, the shape of the current wave is an important factor. This shape is affected by the proportions of the circuit. The average welding apparatus has a lagging power factor of about 0.3 or 0.4. The point on the welding voltage wave, at which a weld is begun has a definite effect on the current wave. If the proper starting point is not chosen, there may be serious current transients, resulting in large amounts of heat being generated at this time. This effect may be marked enough to give inferior welds, due to burning of the stock, and excessive internal stresses caused by a high temperature gradient. By using control apparatus, including thyratron or ignitron tubes, the proper point on the voltage curve, can be picked for the starting point of every weld. By shifting the phase of the current, the temperature gradient can be so controlled that the surface of the stock does not oxodize, while at the contact point the temperature is high enough for a sound weld.

Synchronous motors, in conjunction with magnetic clutches are now used to control the timing of spot or seam welds.

There is one important way in which electrical interruptors are far superior to mechanical ones. Mechanical interruptors may become so adjusted as to start all welds with the same polarity. If the timing of the weld is such that it lasts for an odd number of alternations, this will cause an overabundance of positive or negative alternations. The result will be a building up of a direct current component, and eventually the core of the welding transformer may become saturated and give a number of inferior welds, or no welds at all.

—*Courtesy General Electric*

One-ampere Air-cooled Ignitron for Welding Control



Courtesy General Electric

Combination Spot and Seam Welder Thyratron

This difficulty is obviated with electrical control, by making the polarity of the first half cycle of each weld opposite to the first half cycle of the preceding one.

Primary current is not a criterion of the quality of a weld, for when working on heavy stock, the area of contact may be large, and the current density so low that welding temperature is not attained, in spite of the fact that the current may reach a considerable magnitude.

In spite of the fact that it is not possible to tell whether a weld is good or bad, resistance welding has achieved a prominent place in manufacture today, because when all the controllables—pressure, transients, timing, surface conditions, and cooling rate—are under control, the results are incredibly consistent. Less than one tenth of one percent spoilage has been reported, over a period of two years, by one manufacturer of electric refrigerators.

Electrically controlled resistance welding has also made possible the successful welding of low resistance metals such as aluminum and copper.

Automobile parts, motor frames, machine tool frames, and tanks exposed to liquid and gas pressures, are only a few of the products now fabricated more cheaply, more quickly, and more easily by resistance welding.

EDITORIALS

1885 saw the inauguration on the Cornell Campus of the first regular technical engineering publication. This was the monthly printing of the experimental research bulletins for the Sibley School of Engineering and was called the *Sibley Journal of Engineering.* The Association of Civil Engineers in 1893 followed suit by publishing annually their *Transactions.* In 1907, though, the latter in response to requests expanded to a monthly sheet and included short theses and technical reviews as well as research bulletins. This then formed a civil engineering counterpart to the mechanical's *Sibley Journal.*

There is little to note in changes of policy from this period until 1916 at which time the *Sibley Journal of Engineering* incorporated under that name. At the same time, it appeared as a full size magazine, no longer as a small pocket manual. Four years after, the old civil engineering *Transactions* which had by then become the *Cornell Civil Engineer,* made the same change in size.

By this time both the publications were almost entirely under the control of the students. The faculty acted merely as advisors, attending the meetings and helping to divert troubles ahead of time. The magazines seemed to be on a sound financial basis, the *Sibley Journal* paying regular dividends on its stock and both magazines carrying comparatively high alumni subscription files.

The fiasco of 1929 was the beginning of a chain of events resulting in the union of the two magazines to form the CORNELL ENGINEER. With the depression well under way, advertisers saw fit to cancel contracts, student registration and circulation fell off, and alumni saw a way to save a few dollars. Both magazines saw their operating surplus disappear and the printer's bill mount. It was then that the often discussed plan of combining the publications came up for serious consideration.

The editors felt that not only could operating costs be cut by this union, but the interests of both schools furthered by having a common meeting ground. There was some objection though, since it was proverbial that the civils and the mechanicals should hold each other in disdain, but for many years the electricals and mechanicals had been peacefully represented by one publication, the *Sibley Journal of Engineering.*

Disagreements as to minor details could not be settled until S. C. Hollister became Director of the Civil Engineering School, at which time both staffs of both publications voted for a combination. At the same time, the Cornell Society of Engineers, under the leadership of E. C. M. Stahl, M.E. '13, was planning expansion and seeking an organ for communication to its members.

It was decided, therefore, that the interests of the schools could best be served by uniting the two publications to represent the students and the alumni. Thus THE CORNELL ENGINEER, INC. was founded, the first student publication representative of the entire engineering school. We are now nearing the end of publication of the second volume of this magazine, and this issue marks the ending of the regime of the second staff.

During the last year, the magazine through the mechanics of publication started to settle its feet into the ground and realize its true position on the campus. The editors have striven to produce a magazine up to Cornell standards, modern yet staid rather than showy. It was felt that articles of a lighter vein than those used in the past should be presented. A student publication does not have the facilities to present a technical summary of engineering developments as interesting reading matter. It has therefore been the aim of this staff to cover only some of the more vividly advertised events.

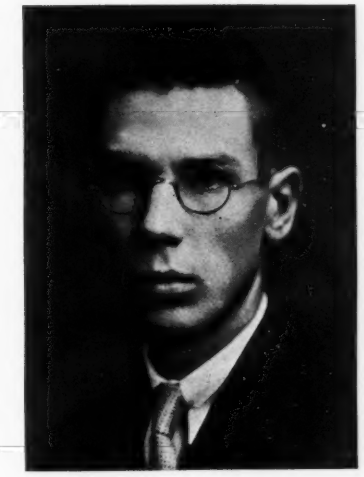
After four years of affiliation with engineering publication work, it is hard to look forward to laying aside the reins. As in all undergraduate work it seems that just when one begins to get the feel of it, the time comes to pass along and uncompleted plans must be laid aside. It is to be expected that the incoming staff should tend to devaluate the work of its predecessors and strike out on its own.

The class of 1937 did so, and it is only now through sad experience, it finds many old discarded policies were really the most effective. Of course if it were not for a constant turn over, there would be little development; but it it discouraging to wonder if our mistakes and training period were of no avail.

Regardless of these reflections, we do feel satisfied and amply repaid for the time put in the office. This work has given us no end of business experience and insight into the troubles of management. Poor are we if we cannot be better followers in an apprenticeship in actual business. Our contacts with faculty members and alumni speak for themselves as being interesting and broadening friendships. So it is with regret, mingled with a feeling of hope, that we submit the direction of this magazine, new in name, yet steeped in age and tradition, to the class of 1938.

This, our last issue, is dedicated, if so it may be called, to the visitors of the College of Engineering on May 1—both sub-freshmen and alumni. We hope that the Show that is presented will be of interest to all and that the sub-freshmen find what they are seeking in the old ivy covered halls on the north end of the Cornell Campus.

Do You Know These Men ?



JAMES ROBERT WANDLING

ROBERT HENRY MENGES

Somebody once said, "If you want a job done well give it to a busy man." Perhaps this accounts for the success of James Robert Wandling '37 CE who has occupied many positions of importance at Cornell and more than made good at them all. His list of extra-curricular activities includes membership in Tau Beta Pi, President of Chi Epsilon, Treasurer of the A.S.C.E., Treasurer of Rod and Bob, Business Manager of The Cornell Engineer, member of the Junior Smoker Committee, C. E. Crew, and C. E. Athletic Manager.

Jim graduated from the High School of Glen Ridge, New Jersey, his home town. Here he was a member of the school orchestra, the football team, Science Club, and the Eligibility Committee. In college he feels that studies develop the analytical mind while participation in extra-curricular activities constitutes an essential phase of a person's education through which he may broaden his acquaintances and gain experience in tactfully meeting people. Publication work especially, Jim feels, gives the opportunity to see business in a small way and see how detail problems are handled.

Wandling spent last summer working in the Buffalo plant of the General Electric Company doing design work and making a study of contract prices. Being partial to hydraulic engineering, Jim enjoyed collecting and assembling data for a proposed drainage system. He hopes to enter into engineering work after graduation, eventually working into an executive position. With such a well rounded background of scholastic and extra-curricular achievement, Jim should enjoy a must successful career in the engineering profession.

The man to whom the Cornell Oarsmen look this year to help them regain the glory of former crews is Commodore Robert Henry Menges '37 AEME. Quiet, modest, and unassuming, Menges, who came to Cornell in 1933 with no rowing experience, has since risen to occupy the most coveted position in the sport.

Bob graduated from Schenley High School in Pittsburgh, Pa., his home town. He came to Cornell expecting to get more from his education than an engineering degree, and has met with more success than anyone could have predicted. The training in thinking things through to a conclusion, and solving the practical problems which one meets in everyday life are among the things which he has worked for, and which he seems to have found. By applying this training to his college activities Menges has earned many campus honors, among which are his appointment to the Freshman Advisory Committee, and the Intercollege Advisory Committee, and election to the Crew Club, Aleph Semach, and Quill and Dagger. Menges, who is a member of Phi Sigma Kappa fraternity, has rowed on the Crew since his freshman year.

Bob likes books and music but his chief pleasure is boating which occupies his time at the family's summer home on Chautauqua Lake in the wilds of western New York. After graduation he hopes to find a place in the steel industry, eventually working into the production department of one of the larger concerns. If the developments Bob has made in himself while here at Cornell are any indication of the changes that will take place in the future, he should live an interesting life.

COLLEGE

The CORNELL ENGINEER takes pleasure in announcing the Publication Board for the coming year and extends congratulations and good wishes to the following men in their new positions.

Editor-in-Chief

George Joseph Kaye, '38 C.E., New York City

Managing Editor

David Benjamin, '38 M.E., New York City

Associate Editor

Aaron H. Sullivan, '38 E.E., Chattanooga, Tenn.

Business Manager

Florian F. Ceperley, '38 M.E., Oneonta, N. Y.

Advertising Manager

Raymond Nicolas Ali, '38 C.E., Pittsburgh, Pa.

Circulation Manager

Robert M. Gifford, '39 A.E., Cleveland Hgts., O.

MODEL FOR FLOOD CONTROL

A scale model of the Chenango River valley through Binghamton is now being completed in the Hydraulic Laboratory on Beebe Lake. The model is being built to a scale of 75 to 1. When completed it will have a total length of 140 feet. It is being constructed for the U. S. Engineers Corps for the purpose of determining the hydraulic characteristics of the river at various stages, and also to study the effectiveness of proposed improvements. The model is open to public inspection.

—o—

SECOND ENGINEER'S BALL

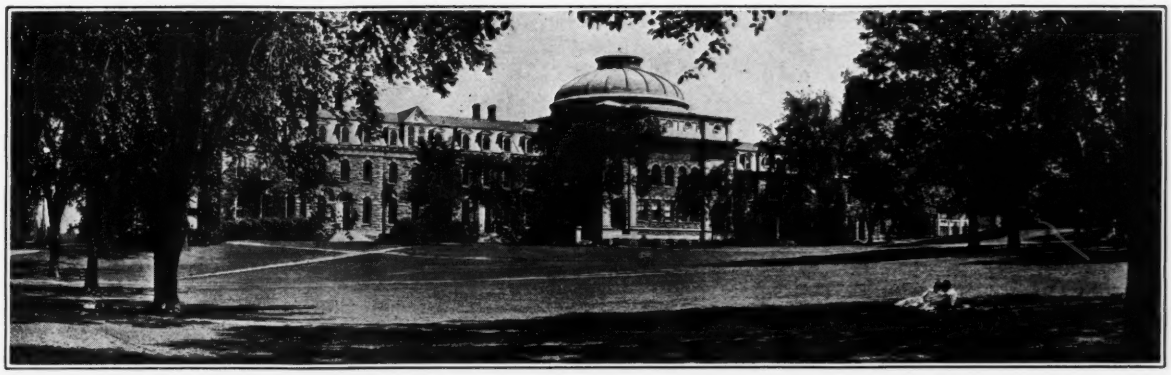
On Saturday evening, May 8, the Engineer's will hold their Second Annual Ball, sponsored by the several honorary engineering societies. It is to be held in the Drill Hall with an as yet unnamed orchestra, though it is generally conceded that a prominent women's band will furnish the music. The proceeds from the Ball are to be used to help defray the expenses of the coming Cornell Day Engineering Show.

SEWAGE WORKS SCHOOL

A very successful three day school for sewer superintendents, sewage plant operators and other city officials interested in sewage and sewage disposal problems was held in Baker Laboratory April 7, 8 and 9. This was a cooperative effort by the Sanitary Engineering Department of the School of Civil Engineering, the Municipal Training Institute of New York State and the State Department of Health.

The School brought over 100 guests to the Cornell Campus, 80 of whom were sewage men enrolled as students, and the remainder supplied the subject matter in the form of lectures. This latter group consisted of men from the various coöperating agencies including the State Board of Health and the faculty of Cornell University. The lectures included discussions on sewage and sewage disposal by Professors H. N. Ogden C.E. '89 and Wm. E. Stanley of the Sanitary Engineering Department, Messrs. A. F. Dappert, F. W. Gilcreas, S. T. Barker, A. S. Bedell and C. C. Agar of the State Department of Health, and nine of the Sanitary Engineers of the District Health units. Messrs. Eustance C.E. '24, Dougherty and Kerr told of operating experiences in Ithaca, while Mr. Henry Ryon C.E. '06, of the New York State Department of Public Works discussed sewage pumps, Mr. H. A. Faber A.B. Chem. '30, of the Chlorine Institute spoke on chlorination and Mr. J. L. Barron, Director of the Division of Sanitation of Westchester County, told of dangers from gas and other hazards in sewers and sewage plants.

An inspection of the Engineering Laboratories was made Wednesday evening, April 7, under the supervision of Professor Wm. E. Stanley assisted by Professor Jenkins and Messrs. Spry and Pendleton of the Civil Engineering School, Professor A. C. Davis and Mr. Fred Erdmann of the Mechanical Engineering School, and Professor R. F. Chamberlain of the Electrical Engineering School.



NOTES

This School was a part of the general program for training of municipal officials by Short Conference Schools originally developed by the Mayors' Conference and now being carried on by the Municipal Training Institute of the State of New York. Similar schools were held at New York City, April 1, 2 and 3, and at Troy, April 14, 15 and 16. These regional schools were developed to provide instruction in modern sewage practice to operators of sewage treatment plants and superintendents of sewers. The region for the Cornell School included the 31 counties of New York State north and west of Delaware County. Attendance records were kept, and certificates of attendance given by the Municipal Training Institute which is an institution chartered by the Regents of the University of the State of New York.

CHI EPSILON INITIATION

The annual spring initiation of Chi Epsilon was held at the Dutch Kitchen on April second. Those initiated were: Raymond M. Ali '38, John W. Gaul '38, George J. Kaye '38, Frank G. Schinzel '38, David H. Gregg, Grad., Maximiano Janario, Grad.

Mr. Richard I. Land, '25 CE, the guest speaker chose for his subject the unique topic of "Humor in Engineering." He reminisced on humorous events in which he had been involved in the construction business, trying to point out that engineering isn't too serious after all. Dean Emeritus Dexter S. Kimball also spoke, telling something of the history of engineering at Cornell.

ROD AND BOD ELECTIONS

At a luncheon meeting held at the Johnny Parsons Club on Saturday, March 27, the Rod and Bob Society elected the following officers for the coming year:

Roy V. Lockwood '38 CE ..... President
Arthur H. Barber '38 CE ..... Treasurer
Clair H. Stevens '38 CE ..... Secretary

SAN FRANCISCO-OAKLAND BAY BRIDGE

On Wednesday, March 3, the Ithaca Section in collaboration with the Student Chapter of the A.S.C.E. played host at a dinner in Willard Straight Hall to Mr. Leon Moisseiff, world authority on suspension bridges. Following the dinner, Mr. Moisseiff spoke before a student A.S.C.E. meeting in Baker Hall concerning the two new California bridges. The speaker revealed the financial and even the political difficulties involved in such a mas-mise project, and stressed the great value of thorough, intensive research and survey prior to any actual construction. The various inovations in bridge design recently employed in California were vividly described with slides of the bridge during construction and the theoretical justifications for the assumptions made in the new design. Mr. Moisseiff explained the needs for and design of the double bridge on the west crossing of the San Francisco-Oakland Bay bridge, the geological difficulties involved, and concluded the talk with a discussion of the methods of spinning the cables and the theory of the deflection of towers of suspension bridges.

TAU BETA PI ELECTIONS

The elections of the following men to Tau Beta Pi were held on March 30, 1937:

W. W. Miller, Jr., A.E., J. Davidson, A.E., N. E. Schlenker, C.E., and D. M. Smith, E.E. of the class of 1937.

D. H. Brown, F. F. Ceperley, R. W. Marchant, G. C. Brainard, Jr., of the class of 1938 in mechanical engineering.

W. L. Bohner, J. A. Pistor, G. E. Marx, E. E. Hughes, R. G. Zens, and K. Hemmerich of the class of 1938 in administrative engineering.

R. M. Reindollar Jr., R. S. Goodwin of the class of 1938 in civil engineering.

H. A. Baxter Chem. Eng. '38, R. H. Ayale and J. D. Anderson, both of the class of 1938 in architecture.

CORNELL SOCIETY *of* ENGINEERS

J. D. TULLER '09, PRESIDENT

WALKER L. CISLER '22, VICE PRESIDENT — ADAM C. DAVIES, JR. '15, VICE PRESIDENT

DAVID HARMON '31 RECORDING SECRETARY — JOHN P. SYME '26, SECRETARY AND TREASURER

"The objects of this Society are to promote the Welfare of the College of Engineering at Cornell University, its graduates and former students and to establish a closer relationship between the college and the alumni."

President's Column

April 5, 1937

Fellow Engineers:

Since the last letter was written for this space, the Cornell Society of Engineers has been honored by the president elect, Dr. Edmund E. Day. He attended and addressed a dinner meeting of the Society, held in the main dining room of the Cornell Club of New York. The engineers present were greatly pleased by Dr. Day's talk, both because it revealed a warm and human personality and because Dr. Day indicated considerable understanding of, and sympathy with, engineering in general and the Engineering College at Cornell.

Either before, or after the dinner, Dr. Day personally met practically all of those present. In his talk, which was informal, the President-to-be gave some inkling of his own ideas as to what the curricula of the engineering schools should contain. It was quite evident that he believes in making the courses strong in the fundamental sciences and that any large measure of specialization is hardly possible in a four year course. I should say, after reading Dean Diederich's splendid article in last month's Cornell Engineer and after listening to Dr. Day, that their ideas are, generally, quite in accord on this subject.

Two things have impressed me as regards Dr. Day—first the enthusiasm displayed toward him by those who have known him for some time and secondly, the unanimity of opinion among those now connected with the University that he is going to make an exceedingly good president for Cornell.

ANNUAL MEETING AND ELECTION OF OFFICERS

For President ..... Gustav J. Requardt '09
For Executive Vice President ..... Walker L. Cisler '22
For Secretary Treasurer ..... John P. Syme '26
Corresponding Secretary ..... David Harmon '31

The above nominations were made by a nominating committee consisting of: E. C. M. Stahl, C. H. Davidson and C. M. Chuckrow. This slate was presented to and accepted by the executive committee at its recent meeting, held at the Cornell Club of New York.

The new constitution provides that additional nominations may be made by members at large but fifty signatures are required for such nominations. Any member may vote by letter ballot for any duly nominated candidate.

The annual meeting is to be held Thursday evening May 6 at 6:30 P. M. at the quarters of the Cornell Club of New York. Mr. R. H. Shreve '02, of Shreve, Lamb & Harmon, designers of the Empire State Building, is to address this meeting. Mr. Shreve's firm is at present preparing preliminary plans for a new engineering building at Cornell.

ALUMNI TRUSTEE

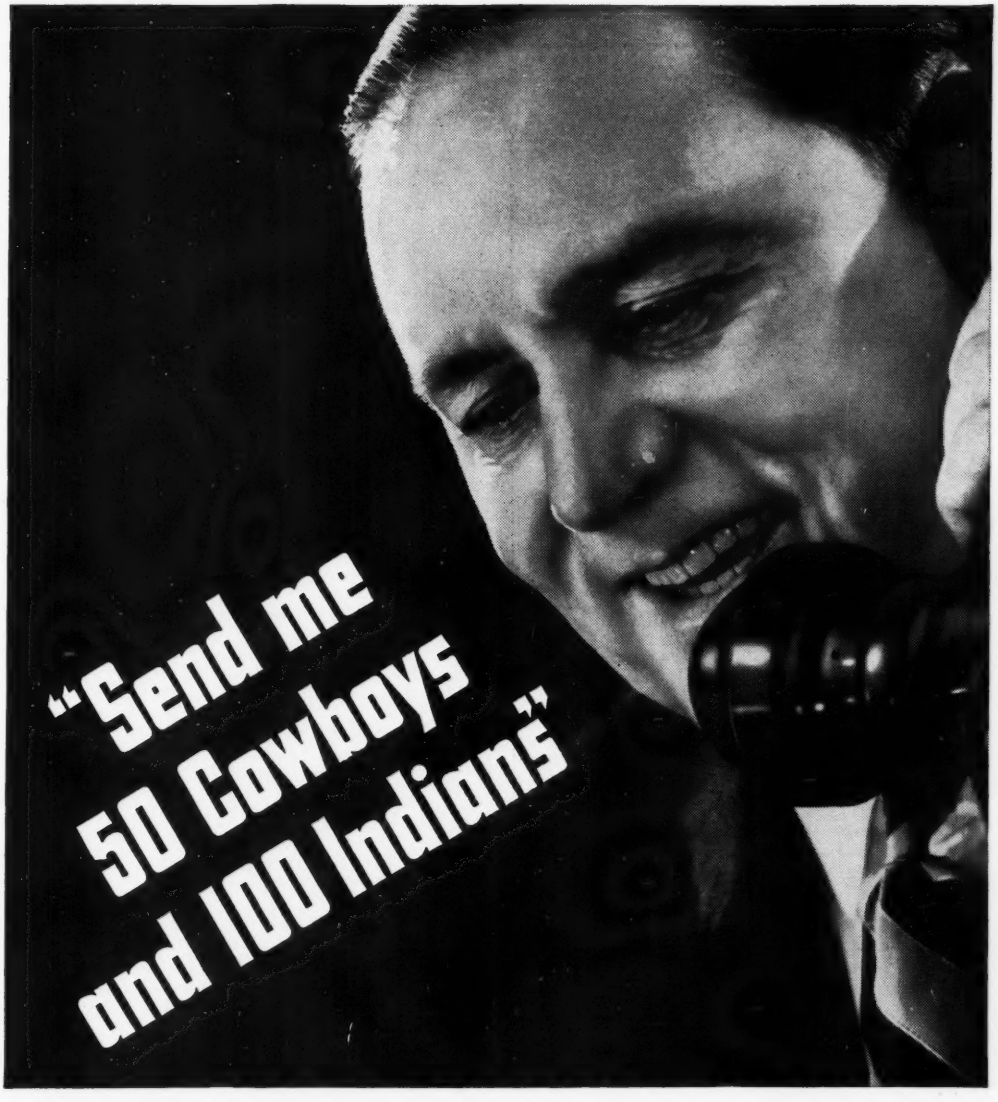
At the last meeting of the executive committee, it was decided to go on record as favoring the candidacy of Mr. Alfred H. Hutchinson, M.E. '09, of Chicago, as a University Trustee.

The Chicago committee, which is sponsoring Mr. Hutchinson for trustee, calls attention to the fact that only three members out of a total of forty on the Board of Trustees, live west of New York State.

Mr. Hutchinson was a member of the Varsity football and track teams while in the University. He is Vice President of the Chicago Cornell Club. At present he has two sons in Cornell.

Sincerely yours,

J. D. TULLER.
President



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Alumni Notes

'07 ME—George Ruhlen is a Colonel in the Coast Artillery Corps; his address, Headquarters Coast Artillery Reserve, 751 South Figueroa Street, Los Angeles, California.

'07 ME—John W. Sheffer's daughter, Jean, was married to Walter D. Switzer '35. Switzer was the captain of the Varsity football team in his senior year at Cornell. Mrs. Switzer's brother, John W. Sheffer Jr., was in the backfield of this year's Varsity football team.

'08 ME—Herbert L. Trube is in the life insurance business at 20 Pine Street, in New York City. He resides in Norwalk, Conn.

'09 CE—Louis Kampf is living at P. O. Box 665, Salem, Mass.

'09 Grad—John C. Page has been appointed Acting Commissioner of the Federal Bureau of Reclamation by Secretary of the Interior Harold L. Ickes.

The Bureau of Reclamation is at present concerned chiefly with the conservation of water resources in the arid and semi-arid sections of the west.

Mr. Page has been with the Bureau since leaving Cornell in 1909, except for brief leaves of absences. He was made Superintendent of the Grand Valley project in 1925. He has also been actively affiliated with the Boulder Dam project, and has served on the National Resources Committee and the President's Great Plains Drought Committee. He went to Washington on Oct. 1, 1935, and received the above mentioned appointment shortly afterward.

Mr. Page is married and has two daughters.

'10 CE—Hurlburt S. Jacoby is director of the Ohio State Research Foundation, a non-profit organization for industrial research. His address is 309 Walhalla Road, Columbus, Ohio.

'11 ME—Julian P. Hickok teaches Drawing and Mathematics at the Simon Gratz High School, Philadelphia, Pa., where he lives at 315 Zeralda Street, Germantown. He has been, since January, 1935, extension secretary of the Henry George School of Social Science.

'11 ME, '15 MME—Herbert B. Reynolds, of Jackson Heights, N. Y., has been placed in charge of the newly consolidated Mechanical Division of the Interborough Rapid Transit Company of New York City.

'11 ME, '24 ME—John K. Rewalt is district manager for the Philadelphia Gear Works with offices in New York City. Chester W. Ludlow '24 is a sales engineer in the same office.

'12 ME—Formerly sales manager of the National Acme Company, Tell Berna has been appointed General Manager of the National Tool Builders' Association, with offices in Cleveland, Ohio.

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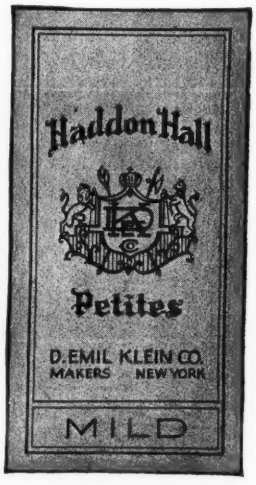

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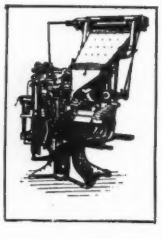

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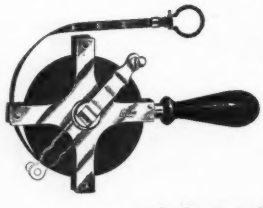

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Ryan, the new foreman, addressed the crew:

"Men, you're working for me and I want you all to know what's what. I can lick any man in the shop."

A big, brawny chap stepped out and said: "You can't lick me."

"Oh, I can't?" said Ryan.

"No, you can't." said the brawny one.

"Go to the office and get your pay. I'll have no man working for me that I can't lick," said Ryan.

"What's the matter here?" asked the policeman of the battered man lying on the sidewalk outside an apartment house.

"Oh, just absent-mindedness," was the reply.

"What are you talking about?" retorted the officer.

"Well, you see I live on the fourth floor of this building. My wife and I are both absent-minded. I just came home from a long business trip, and my wife and I were at the dinner table when a step sounded in the hall and someone tried the door. Well, my wife is so absent-minded that she said 'Goodness, here comes my husband, and I'm so absent-minded that I jumped out of the window."

A young lady recently visited the locomotive works and then later told some of her friends how a locomotive is made.

"You pour a lot of sand into a lot of boxes," she explained, "and you throw old stove lids and things into a furnace, and then you empty the molten stream into a hole in the sand, and everybody yells and swears. Then you pour it out and let it cool and pound it, and then you put it in a thing that bores holes in it. Then you screw it together, and paint it, and put steam in it, and they take it to a drafting room and make a blue print of it. But one thing I forgot—they have to make a boiler. One man gets inside and one man remains outside, and they pound frightfully; and they tie it to the other thing, and you ought to see it go!"

The grizzled mountaineer sat in the kitchen with his wife. They were drinking corn liquor out of a gallon jug. At 4 a. m. the door opened, and their pretty eighteen-year-old daughter breezed in.

The old man jumped up.

"Where yo' been?" he thundered.

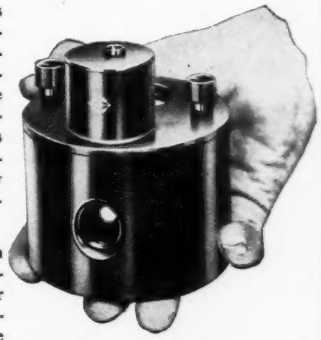
"Nowhere," returned the girl easily. "Nowheres."

The mountaineer slammed the jug on the table.

"Don't yo' lie to me," he bellowed. "Any gal who comes home sober at this hyer hour has been up ter somethin'!"

—*Excavating.*

CAMBRIDGE POT GALVANOMETER



• This galvanometer is an inexpensive instrument with the sensitivity of a reflecting galvanometer and the ruggedness of a milliammeter. It requires no levelling or clamping and is accordingly well adapted for general laboratory use.

It is fitted with both a pointer and a reflecting mirror suitable for "null" point indications as well as for use with a lamp and scale. It is only one of many Cambridge Galvanometers.

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Stress and Strain

Lady (at party)—"Where's that pretty maid who was passing out the cocktails a while ago?"

Hostess—"Oh, are you looking for a drink?"

Lady—"No, I am looking for my husband."

Prof: A fool is a person who asks questions which even wise men can't answer.

Student: No wonder I flunk all your prelims.

C.E. Why is a locomotive like a baby?

M.E. I'll bite.

C.E. Because it has a little tender behind.

It wasn't my fault. I wouldn't have taken the date, but Harry's girl liked her and wanted to see her get around. I didn't have any excuse, and they bought my ticket to the Frolic.

When she came down the stairs I shuddered. I grabbed Harry. She was dressed in lavender or something, her slip showed decidedly, her dress was low in the back, and I could see her skinny bare shoulder blades. Her hair was corn color, and she wore horn-rimmed glasses. She liked me, of course, and made passionate love all the way down. When we danced I held her away as much as possible, but I couldn't prevent her knees from knocking mine.

On the way home, she said she liked my car better than hers. I asked what kind of a car she had, and she said it was a Packard. I wondered what business her father was in, and she said he was president of a big bank in Omaha. In June, we were married.

—*Nebraska Awgwan.*

A Negro funeral once was attended by a ventriloquist whose peculiar powers were not known to the others present. Another Negro told what happened at the cemetery.

"Well, sur," he started, "When dey begins to lowah Joe into de hole, he says, 'Lemme down easy boys'."

"Did they go ahead and bury him?" asked the other man.

"How de world does I know? I led de pack."

The day was warm, the hour late,
But the Editor's work all had to wait,
With nervous steps he paced the floor
And looked askance at the card he bore . . .
Then suddenly, quickly—a timorous tap.
With puzzled expression, he answered the tap.
It was a frosh with face scared and wet;
"I sent you a joke—did you get it yet?
The editor groaned, as he looked at the card . . .
"Not yet," he shrieked . . . "but I'm trying hard!"

In all this country you will not find a store as unique or interesting as this;—over 30,000 items —and as one old timer put it, everything from lingerie to a micrometer.

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Who knows, perhaps we are.

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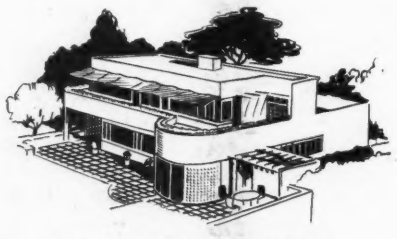
G-E *Campus News*

IN EVANSVILLE

Into the flood zone several General Electric engineers—among them Henry Duval of Washington University, Eugene Darlington of Oregon State, and Harold Towlson of Clarkson Tech—took two radio-equipped police cars and played an important part in the relief activities along the Ohio Valley. The equipment included a two-way ultra-short-wave police radio set in each car, a 50-watt headquarters transmitter, and a 150-meter transmitter having its own gas-engine-driven electric generator—in reserve in case of power failure.

One of the engineers reported, "We arrived in Evansville and erected our antenna on the 75-foot tower of a bank building. We were on the air continually, rendering service to the flooded area."

In a further effort to aid flood victims, General Electric sent extra men to the G-E Service Shops in the affected area to speed repair work.



IT'S "NEW AMERICAN"

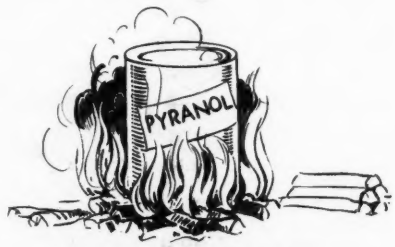
Conceived by General Electric, the "New American" home promises to influence profoundly the trend in American building. The program is sponsored in co-operation with all those professionally interested in building new and better homes.

The modern kitchen is one of the results of this work. It has been changed from just a room where a variety of tasks must be performed to a scientifically planned workshop. It is equipped with electric appliances which do the drudgery of kitchen work silently and easily. The electric range, refrigerator, dishwasher, Disposall unit, and modern lighting are but examples of the improvements which have been made in the home workshop.

The radial wiring system used in the "New American" home was designed for safety and convenience. Plenty of outlets for lights and for appliances are the outstanding features of this system.

The home is thoroughly air conditioned. Conditioned air is not only more comfortable but also more healthful, and the G-E air-conditioning units have been designed to promote such conditions.

With the elimination of wasted space, steps, and time throughout the entire dwelling—with the maximum in health, comfort, and economy—the "New American" home is building a brighter future for the cottage and the mansion.



IT WON'T BURN

Noninflammable and nonexplosive, this new cooling and insulating liquid, Pyranol, was developed by General Electric for use in transformers, capacitors, and cable. Its unusual characteristics have been recognized by the National Electrical Code, making it possible to install transformers indoors and at the load centers, without fireproof vaults. This results in savings in secondary copper and installation costs.

Pyranol is chemically stable and does not sludge, a feature which minimizes maintenance. Experience to date has showed that the materials used in Pyranol transformers have a longer life than under oil. The result—longer transformer life.

Pyranol transformers were first used in 1932, and now more than 700 units, totaling more than 200,000 kva of transformer capacity, have been installed, all giving excellent service.

96-375DH

GENERAL ELECTRIC